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Design and Fabrication of Two Row Paddy Transplanter

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Abstract - *India is an agrarian country. About 70% of Indians are dependent on agriculture for their livelihood. India is world's second largest producers of rice, accounting for 20% of all world rice production. Rice is usually grown by planting paddy in the fields manually. With this method of planting rice paddy, labour cost increases and it is a very time-consuming process. The manual process can be mechanized using the rice planting machine. It reduces labour cost and time to plant rice paddy. This machine works on a simple mechanism, which is easy to maintain and it is eco-friendly. This machine requires only one person for its operation. So, the main aim of this project is to design and develop a rice planting machine which is compact and affordable which can be operated easily by a single person, which will help the farmers to make the whole rice planting process easier and combat the lack of labourers in the farming sector.*

Key Words: Agriculture, Four bar mechanism, Rice planter, Design and Fabrication, Compact

1. INTRODUCTION

India is second largest agricultural country, about 70% of the population of India is dependent on farming directly or indirectly. Most of the farmers are still using the traditional method of farming. The time is changing and things need to change as well in order to develop the methods and equipment, the transition has not yet occurred completely because of the high cost of initial investments that is needed. Agriculture also plays a vital role in the Indian economy; it contributes to the one sixth of the total GDP. The Government of India has also started taking steps in the form many initiatives and subsidies in which the farmers are made aware about the technologies they can use in farming. There are basically five steps that a farmer needs to do properly to get increased productivity. These five steps namely are: Ploughing, Seed sowing, Irrigation Process, Harvesting, Threshing.

1.1 Impact of the technology:

Introducing the technology to the rice farming will result in many advantages such as better production, good quality of produce, less labour required, saves time, low cost. Due to the impact of modernization and urbanization the agriculture sector is experiencing a labor shortage and the increased cost of the wages which can be detrimental to the average farmer. So by using the machinery the problem faced by them can be overcome.

1.2 Advantages of mechanization:

To plant the rice saplings a rice Transplanter has been developed and in many countries like China, Japan, Korea, etc. it is already brought in use. But here in India the rice Transplanter is not affordable to the farmers because of the high cost of machine, maintenance and transport requirements. The imported rice Transplanter working on diesel engine is not affordable to the average Indian farmers. So, a manual rice Transplanter is needed so that the cost of Transplanter decreases. In manual transplanting practice, 8-12 labors are required to transplant one acre. However, if a self-propelled rice Transplanter is used, three people can transplant up to four acres in a day.

2. LITERATURE REVIEW

For this project, we searched different papers for information regarding transplanting mechanism. We tried to analyze different factors such as like ergonomics, performance and its effect on crop yield, theoretical development of rice transplanting machine. This study was conducted which gives the parameters, specification, problems arising in already exists transplanter and development & design methodology of transplanter. The following papers were analysed and the findings are discussed below.

1. Design & Development of Rice Planter Machine, Dhanesh D Patil, Dr.Mangesh R Phate, ISSN 2347-6710, Vol. 5, Issue 7, July 2016. They used 4 row, 3 row and 2 row rice Transplanter on the basis of their study of various parameters and concluded that the 3-row rice transplanter was the best among all transplanting methods. However Due to higher cost of 3 row rice Transplanter, we decided 2 row rice planter is economical and effective.

2. Design Analysis and Fabrication of Manual Rice Transplanter, Satish Kumbhar, Sangram Khot, ISSN 2347-6710, Vol. 6, Issue 3, March 2017. The cost is cheap than motor and hand cranked mechanical rice transplanter. The

four-bar mechanism gives the each operating and maintenance with less part which reduces the weight. Therefore, four bar mechanism is implemented for giving a simple and easy operation of rice transplanter machine.

3. Ergonomic Evaluation of Manually Operated Six-Row Paddy Transplanter, Rajvir Yadav, Mital Patel, ISSN 147- 157, 2007 The height at which push-pull forces were applied was the most important variable in affecting the force output. They concluded that the foot placement, handle height and body postures all affected the push-pull strength. Further reported that the posture of workers, while performing some tasks is another factor that can influence energy requirements. Transplanting in bending posture required the highest energy than any other posture. The body posture during the push and pull force is important factor while transplanting.

3. WORKING PRINCIPLE

The worker provides the force which initializes the start of this mechanism, the rice transplanter moves forward rotating the wheels that touch the ground. The wheels are provided with the fins so that they can travel easily in the mud. The finned wheel ensures proper spacing between successive planting. Then we have larger sprocket is provided on the same shaft with the finned wheel and hence at the same time sprocket will also rotate. The larger sprocket is in engagement with the smaller sprocket by using the chain drive. As the power will get transmitted to the smaller sprocket, it will rotate. 3:1 gear ratio is used to increase the speed. On the same shaft planting finger will be attached to the four bar linkage so that it will oscillate for certain angle. As the planting finger oscillates, it will pick the rice saplings from the tray and plant them in the mud. The planting finger is designed in such a way that rice plant should be easily picked during the downward motion.

4. DESIGN CALCULATION

4.1 Design of Ball bearing:

Bearing No. 6202 (Data book page.no 4.13)

Outer Diameter of Bearing (D) = 35 mm

Thickness of Bearing (B) = 12 mm

Inner Diameter of the Bearing (d) = 15 mm

r_1 = Corner radii on shaft and housing

r_1 = 1(From design data book)

Mean Diameter (d_m) = (D + d) / 2

= (35 + 15) / 2

d_m = 25 mm

4.2 Design of Chain drive:

STEP 1: Type of Chain

Roller Chain is selected.

STEP 2: Determination of Transmission ratio

$i = N_1/N_2 = 1$ (From Data book page no. 7.74)

STEP 3: Standard number of teeth on pinion sprocket

$Z_1 = 15$ (Assume)

STEP 4: Standard number of teeth on wheel sprocket

$Z_2 = i*Z_1 = 15$ (From Data book page no. 7.74)

STEP 5: Selection of standard pitch

P = a / (30 to 50) (From Data book page no.7.74)

a = 600mm (Assume)

P = 600/40 = 15mm

Standard pitch = 15.875mm

STEP 6: Check for factor of safety

Fsw = Breaking load / Design load

where,

Design load = Pt * Ks = 2.56 * 10^3 N

So, Fsw = 44400 / 2.56 * 10^3 = 17.3

Allowable FOS = 11

Since calculated FOS is greater than allowable FOS. Hence the design is safe.

STEP 7: Bearing stress

Bearing stress of roller = (Pt * Ks) / A (From Data book page no. 7.77)

$A = 1.40cm^2 = 1.40 * 10^2 mm^2$

Bearing stress of roller = $18.4 N/mm^2$

STEP 8: Calculation of length of chain

$lp = 2ap + (Z_1+Z_2) / 2 + (((Z_1 + Z_2) / 2Л) / ap)^2$

= 75.54 + 15

= 90.59mm

$ap = a_o / P = 37.795mm$

L = lp * P = 1438.1mm

STEP 9: Calculation of exact center distance

a = ((e ± e – 8m) / 4)* P (From Data book page no. 7.75)

e = lp – ((Z1 + Z2) / 2) = 90.59mm

$m = ((Z2 – Z1) / 2Л)^2$

So, a = 719.05mm

5. 2D – LAYOUT

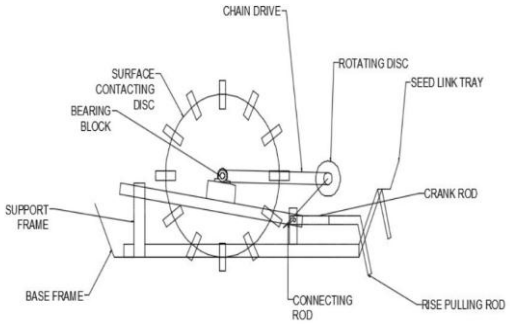

Fig -1: 2D-Layout of the planter

The 2D designing and drafting of the planter is done using AutoCad according to the design requirements and calculations.

6. 3D – LAYOUT

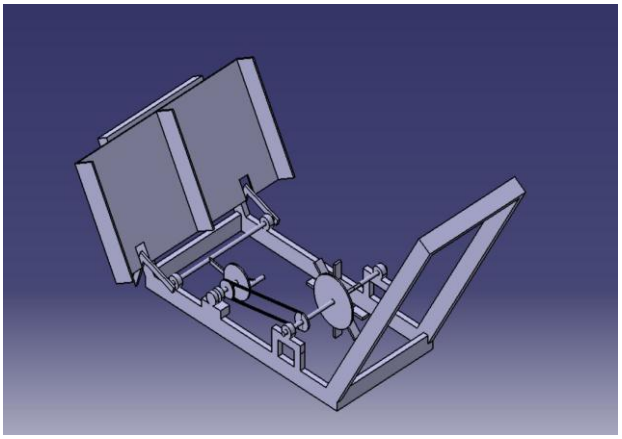

Fig -2: Isometeric View

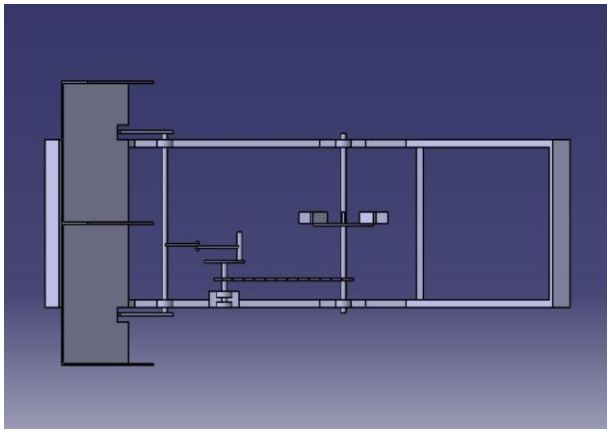

Fig -3: Top View

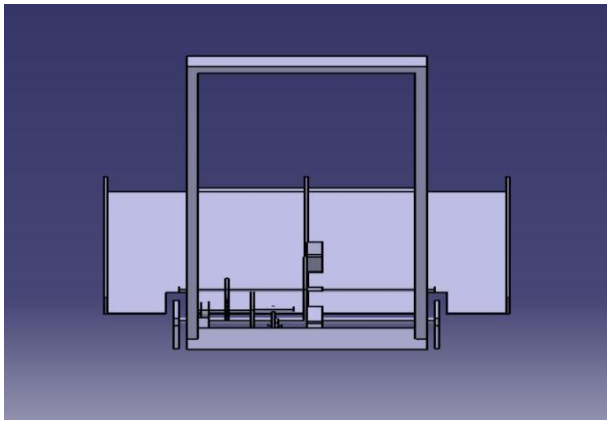

Fig -4: Front View

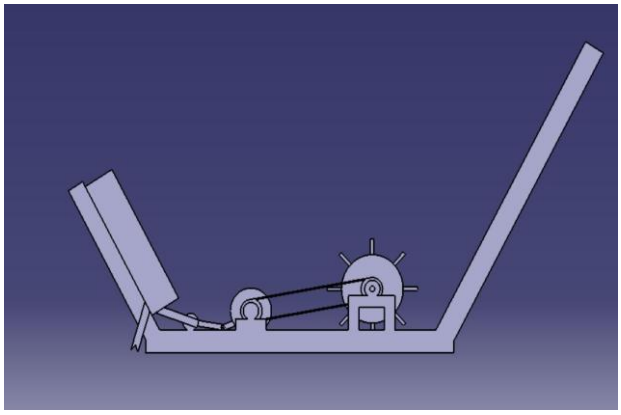

Fig -5: Side View

7.FABRICATED MODEL

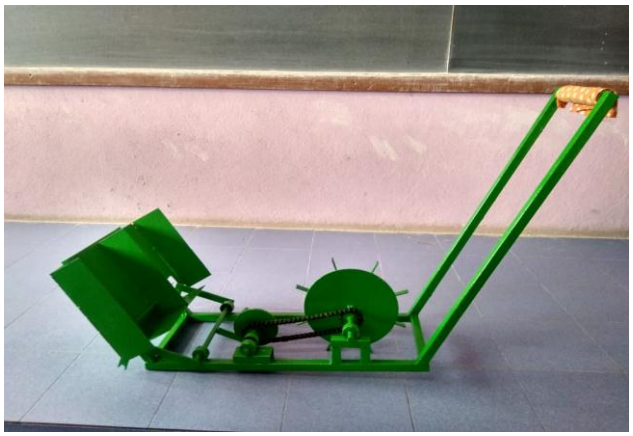

Fig -6: Fabricated Model

8. ADVANTAGES

- Reduced human effort.
- Easy to control.
- Simple design.
- Production cost is low.
- Higher productivity compared to traditional method.

9. CONCLUSIONS

The rice planting machine has been designed and fabricated satisfactorily. Finally we can say that it is a user friendly and efficient machine with low production cost. But, there is always a room for improvements. The machine is driven by man power but engine can be coupled to enhance the performance. Machine can be developed to transplant several rows simultaneously. The dapog must have thin mud layer for easy removal of seedlings.

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